The Varying Impacts of Agricultural Support Programs on U.S. Farm Household Consumption

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Farm households are economic agents whose income is derived from farm, off-farm, and government sources. This article uses farm-level data from the Agricultural Resource Management Survey (ARMS) and recent advances in the econometric theory of dynamic pseudo-panels to show that farm households consume various sources of income differently at the margin. Particular attention is given to a specific type of lump-sum government transfer payment intended to be decoupled from (independent of) farm production decisions. The results suggest that relatively decoupled government subsidies have a greater marginal effect on farm household consumption than subsidies that are tied to market conditions.

Key words: agricultural subsidies, consumption, pseudo-panels.

Farm households often receive income from off-farm employment and government support payments in addition to farm production revenues. If income is fungible, then marginal consumption should not vary by income source. However, Carriker et al. (1993) show that farm household consumption does vary at the margin by income source. They find that off-farm income and income from government subsidies are consumed at a higher marginal rate than income from farm production revenues. If farm household consumption varies at the margin by income source, different types of government payments may affect consumption differently. Closely following Carriker et al. (1993), this analysis further disaggregates sources of farm household income and compares how different types of government payments affect farm household consumption. It is shown that government payments that are relatively "decoupled" from farm production decisions are consumed at a much higher marginal rate than government payments that vary according to market conditions.[1]

Since the study by Carriker et al. (1993), the structure of U.S. agricultural policy has undergone significant changes. One change in particular was the creation of a new type of government subsidy under the 1996 Federal Agricultural Improvement and Reform (FAIR) Act intended to be "decoupled" from (independent of) farm production decisions. The purpose of this payment was to increase the consumption, savings, and investment of farm households without affecting farm production decisions (Burfisher and Hopkins 2003; Westcott and Young 2004). These payments continued under the 2002 Farm Security and Rural Investment (FSRI) Act and are included in the Food, Conservation, and Energy Act of 2008. They are paid to qualifying farm households with few restrictions as to what or how much they produce. Other types of government payments are more volatile, being paid only in times of poor agricultural production or low commodity prices. Still others are paid for the conservation of agricultural land that is environmentally sensitive. If these different types of payments affect farm household consumption in different ways, some payments may be better suited to achieving a specific policy objective than others.

Data for the analysis are taken from the U.S. Department of Agriculture's (USDA) Agricultural Resource Management Survey (ARMS) for the years 1998 to 2004.[2] Because

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[1] All references to marginal consumption are for short-run estimates. Unlike Carriker et al. (1993), estimates for long-run marginal rates of consumption are not reported.

[2] Data from ARMS are gathered by the U.S. Department of Agriculture's National Agricultural Statistics Service (NASS). Information about the survey can be found at http://www.ers.usda.gov/Briefing/ARMS/.

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ARMS data do not observe individual farm households over time, a pseudo-panel of data is created that observes groups of relatively homogeneous farm households over time. An empirical analysis, based on the theoretical model developed by Carriker et al. (1993), employs advances by McKenzie (2004) in the econometric theory of dynamic pseudo-panel analysis.

Sources of Farm Household Income

Farm households rely on a variety of revenue streams. The instability of income from farm production leads total farm household incomes to vary more from year to year than the incomes of other U.S. households (Mishra et al. 2002). Income from farm production is volatile over time due to changing weather conditions, fluctuations in agricultural prices, changes in the price of production inputs, or changes in farm size. Besides revenue from farm production, most farm households receive income from off-farm and government sources. Nearly 76.4% of all family farms have at least one person, either the principal operator, spouse, or both, laboring off of the farm for a wage or salary (Hoppe and Banker 2006). Farm households may also receive unearned income from off-farm financial or business investments.

Farm households receive billions of dollars in U.S. government subsidies every year from a variety of policy instruments. One type of payment is largely decoupled from production or commodity price outcomes.[3] These decoupled payments are tied to agricultural land (called "base" acres under the 2002 FSRI Act) that has a history of producing certain field crops: wheat, rice, corn, sorghum, barley, oats, upland cotton, soybeans, peanuts, and other oilseeds. They are paid to the operators of base acreage generally without regard to what crops they produce in the current period, or even if they produce any crops at all.[4] They are also paid independent of commodity prices in the current period. For farm households, decoupled payments are fixed by law and relatively stable between periods of farm legislation, varying only when base acres are sold, rented, or taken out of agriculture (Burfisher and Hopkins 2003; Westcott and Young 2004).

Some agricultural subsidies are paid out only under unfavorable market conditions. Marketing loan programs such as the loan deficiency payment (LDP) and marketing loan gains (MLG) essentially provide a price floor when market prices fall below legislated per-unit loan rates (Westcott, Young, and Price 2002). In an attempt to reduce farm household income variability, these payments are designed to supplement farm household income in years when revenue from farm production is low due to low commodity prices.

Various types of environmental conservation program payments are also available to help farmers address specific environmental problems. These payments are made mostly to smaller rural-residence and retired farm operators. The bulk of these are Conservation Reserve Program (CRP) payments to farm operations that remove land from production for a period of ten to fifteen years (Lambert et al. 2006). Other payments include Wetland Reserve Program (WRP) payments and Environmental Quality Incentives Program (EQIP) payments.

Model

There are several models that demonstrate the relationship between consumption and income, including the permanent income (Friedman 1957), life-cycle (Ando and Modigliani 1963), and behavioral life-cycle (Sheffrin and Thaler 1988) hypotheses (PIH, LC, and BLC, respectively). This article uses a theoretical model set forth by Carriker et al. (1993), who modify the traditional LC model to allow for different sources of income to account for a fixed percentage of total consumption. They show that if incomes are fungible, the LC model can be written as

$$(1) \qquad C_t = \beta_0 + \beta_1 \sum_{s=1}^{z} Y_{st} + \beta_2 C_{t-1} + \beta_3 W_t$$

where Y_{st} is income in time period t from source s and β_1 is the short-run marginal propensity to consume income from all sources. The variable C is consumption and W is a measure of wealth.

Carriker et al. (1993) state that this specification of consumption is incorrect if incomes are not fungible. They create a system of consumption equations in which a fixed percentage of consumption is assigned to each source of income Y_{st}.

[3] While these payments are intended to be decoupled from production, there are several ways in which they might indirectly affect production (Hennesy 1998; Young and Westcott 2000).

[4] One exception is the restriction of planting fruits and vegetables on base acres under certain conditions (Young et al. 2007).

$$(2) \quad \lambda_s C_t = \beta_{0s} + \beta_{1s} Y_{st} + \beta_{2s} \lambda_s C_{t-1} + \beta_{3s} W_t.$$

Equation (2) is a representative equation from this system where s indexes one of z sources of income. The share of total consumption (C_t) purchased with income from source s is λ_s, where $\sum_{s=1}^{z} \lambda_s = 1$.

Carriker et al. (1993) also state that because λ_s is unknown, individual equations for each source of income cannot be empirically estimated. By summing across the s equations, they derive equation (3)

$$(3) \quad \sum_{s=1}^{z} \lambda_s C_t = C_t = \sum_{s=1}^{z} (\beta_{0s} + \beta_{1s} Y_{st} + \beta_{2s} \lambda_s C_{t-1} + \beta_{3s} W_t)$$

which can be rewritten as

$$(4) \quad C_t = \beta_0^* + \sum_{s=1}^{z} (\beta_{1s} Y_{st}) + \beta_2^* C_{t-1} + \beta_3^* W_t$$

where $\beta_0^* = \sum_{s=1}^{z} \beta_{0s}$, $\beta_2^* = \sum_{s=1}^{z} (\beta_{2s} \lambda_s)$, and $\beta_3^* = \sum_{s=1}^{z} \beta_{3s}$. Equation (4) is an estimable equation in which the short-run marginal propensity to consume income from source s (β_{1s}) is preserved for all z sources of income.

Empirical Considerations

Data on farm household income, wealth, and expenditures are taken from the ARMS survey. This survey is conducted each year by the USDA's National Agricultural Statistics Service (NASS) and collects data from thousands of farm operators. The ARMS data set does not constitute a true panel of data. Rather, it is a cross-sectional survey repeated each year where observations present in one year are not known to be present in other years. A pseudo-panel of data is therefore constructed by creating cohorts of observations within each cross-section whose characteristics are unlikely to change over time (Deaton 1985; Verbeek and Nijman 1992). These cohorts are treated as cross-sections that are observed over time, using cohort means as the relevant observation data points. Because equation (4) contains a lagged dependent variable, the estimation of a dynamic model using a pseudo-panel of data must be considered. Relatively few theories have been developed to address the issues involving the estimation of dynamic pseudo-panels (Moffit 1993; Collado 1997; McKenzie 2004; Verbeek and Vella 2005). This article follows McKenzie (2004).

Because ARMS data do not observe the same farm operation over time, each operation i is indexed with a time period t to indicate the period in which the individual farm operation is observed. Following McKenzie (2004), equation (4) is rewritten in its econometric form as

$$(5) \quad C_{i(t),t} = \beta^*_{0i(t),t} + \sum_{s=1}^{z} (\beta_{1s} Y_{si(t),t}) + \beta_2^* C_{i(t),t-1} + \beta_3^* W_{i(t),t} + u_{i(t),t}$$

where $u_{i(t),t}$ is the error term. The intercept term ($\beta^*_{0i(t),t}$) for each farm operation is assumed to be normally distributed around some cohort mean, or $\beta^*_{0i(t)} = \beta^*_{0c} + \mu_{i(t)}$, where farm operation $i(t)$ belongs to cohort $c(t)$ and no other cohort. The cohort intercept term (β^*_{0c}) is specific to each cohort and is time invariant. The individual variation from the cohort mean ($\mu_{i(t)}$) represents individual farm operation fixed (time invariant) effects.

Equation (5) cannot be estimated because lagged consumption for farm operation i observed in time period t, or $C_{i(t),t-1}$, is not observed. This is due to different farm operations being surveyed for each year the cross-section of data are gathered. In order to estimate equation (5), cohorts of farms whose characteristics are unlikely to change over time are used to represent individual observations. For each variable, values for the i farm operations in each cohort are summed and divided by the i observations to obtain cohort mean values. Equation (5) is rewritten as

$$(6) \quad \bar{C}_{c(t),t} = \beta^*_{0c} + \sum_{s=1}^{z} (\beta_{1s} \bar{Y}_{sc(t),t}) + \beta_2^* \bar{C}_{c(t),t-1} + \beta_3^* \bar{W}_{c(t),t} + \bar{\mu}_{c(t)} + \bar{\nu}_{c(t),t}$$

where a bar indicates the cohort mean of the relevant variable.

Equation (6) still cannot be estimated as the mean consumption of cohort $c(t)$ is not observed in time period t-1. However, McKenzie (2004) suggests that one might reasonably use the mean consumption of cohort $c(t-1)$, which is observed in time period $t-1$, as a proxy. With the assumption that the coefficient β_2^* is the same for cohort c observed in every period, $\beta_2^* \bar{C}_{c(t-1),t-1}$ is both added and subtracted from

equation (6), yielding a net effect of zero. Rearranging these terms yields

$$\bar{C}_{c(t),t} = \beta^*_{0c} + \sum_{s=1}^{z} (\beta_{1s} \bar{Y}_{sc(t),t}) + \beta^*_2 \bar{C}_{c(t-1),t-1} + \beta^*_3 \bar{W}_{c(t),t} + \varepsilon_{c(t),t} \quad (7)$$

where $\varepsilon_{c(t),t} = \beta^*_2(\bar{C}_{c(t),t-1} - \bar{C}_{c(t-1),t-1}) + \bar{\mu}_{c(t)} + \bar{\nu}_{c(t),t}$. Equation (7) can now be estimated because all of the variables are observed in the pseudo-panel of data.

The error term ($\varepsilon_{c(t),t}$) in equation (7) contains the difference between the real, unobserved cohort consumption, $\bar{C}_{c(t),t-1}$, and its proxy, $\bar{C}_{c(t-1),t-1}$. The error term is therefore correlated with the independent proxy variable for lagged consumption ($\bar{C}_{c(t-1),t-1}$), but not for the reasons found in true panel data sets. In true panels, the lagged dependent variable is observed. In equation (6), if the lagged dependent variable ($\bar{C}_{c(t),t-1}$) were observed, the time-invariant cohort effects ($\bar{\mu}_{c(t)}$) that affect consumption in time period t would also affect consumption in time period $t-1$. This correlation does not exist in equation (7) because a proxy is used for lagged consumption. The time-invariant cohort effects ($\bar{\mu}_{c(t)}$) are not correlated with $\bar{C}_{c(t-1),t-1}$ as $c(t)$ and $c(t-1)$ contain different sets of observations. The correlation between the lagged proxy and the error term in equation (7) comes from the lagged proxy being part of the error term, leading OLS results to be biased.

This bias can be overcome using instrumental variable (IV) techniques. McKenzie (2004) suggests that the most logical instrument for lagged consumption ($\bar{C}_{c(t-1),t-1}$) is twice-lagged consumption ($\bar{C}_{c(t-2),t-2}$). He also notes that all lagged independent variables may also serve as instruments, but including them will increase the variability of the results. The predicted values of $\bar{C}_{c(t-1),t-1}$, calculated using instrumental variables, are no longer correlated with the error term ($\varepsilon_{c(t),t}$) in equation (7). The OLS estimates of equation (7) are compared with IV estimates that use twice-lagged consumption and all lagged independent variables as instruments.

Data and Variables

The ARMS data set is intended to be representative of the entire U.S. agricultural population. The survey is conducted using stratified sampling techniques to ensure that all types of agricultural production are represented. Because of the nature of stratified sampling, an observation is weighted such that it represents similar farms within the same state. Cohort means are weighted accordingly in the analysis with the weights determined by NASS. Data are taken from the 1998–2004 ARMS data sets. All nonfamily farms are excluded as well as farm households with extremely low incomes.[5]

Pseudo-Panel Construction

The difficulty in creating a good pseudo-panel lies in the construction of the cohort. Just as the individual in the panel data, the cohort in the pseudo-panel should have time-invariant characteristics that can be controlled. Observations should be homogeneous within cohorts and heterogeneous across cohorts, even though different observations are used for each cohort from year to year. In this analysis, geographic location and farm production specialty categories are used to create the cohorts.

The forty-eight continental states are combined with nine production specialty categories to create a potential 432 cohorts. However, only cohorts with at least ten observations are included in the analysis. Because all commodities are not produced in all states, there are only 153 state-commodity cohorts used in the analysis. Over a seven-year time period, there is a total of 1,072 cohort observations. Because a lagged dependent variable is required for OLS techniques, the year 1998 is omitted leaving only 918 cohort observations. Instrumental variable techniques require twice-lagged values, eliminating the years 1998 and 1999 and leaving only 765 cohort observations.

Cohorts range in size from ten observations to 646 observations with an average size of seventy observations. Deaton (1985) raises the issue that small cohort sizes may lead to biased estimates due to sampling error. Verbeek and Nijman (1992) suggest that sample sizes of 100 to 200 observations per cohort should be

[5] Nonfamily farms are defined as any farm organized as a nonfamily corporation or cooperative. It includes farms that are operated by a hired manager. In 2004, nonfamily farms accounted for 2.2% of all farms. Farm households with low incomes, or "limited-resource" farms, generally have total household incomes below the poverty line and limited agricultural sales. In 2004, over 72% of limited-resource farms had negative farm earnings and almost 20% had negative household incomes. They are therefore excluded from the analysis. Limited-resource farms accounted for less than 10% of all farms in 2004. See Hoppe et al. (2007) for additional statistics and more information on farm household classifications.

sufficient to yield unbiased estimates from random samples, but Devereux (2007) argues that sample sizes must be much larger (in the thousands) to yield unbiased results. These studies are based on randomly drawing a subsample of observations from larger groups. However, in this analysis, the data are sampled using a stratified sampling technique; farms with certain characteristics are oversampled. Cohort means are therefore weighted according to the stratified nature of the sample selection process. The weights are constructed such that each individual observation represents hundreds, or even thousands of similar farms within the same state.

Production specialty, if correctly categorized, combined with location can provide a relatively homogeneous group of farm operations that are less likely to change across time. For example, sorghum, corn, and soybeans are all row crops, meaning that the farm operator has the technology and knowledge to switch between the commodities with relative ease. Wheat, oats, and barley, on the other hand, are not row crops, so require a different method of production. Therefore, farm operators are less likely to switch between corn and wheat production. Thus, corn, soybean, and sorghum farmers are included in the same cohort while wheat, oats, and barley producers belong to a different cohort. This also groups farms by commodities that farmers may produce simultaneously in order to reduce risk through production diversification. Table 1 lists the commodity groupings that are used to create the cohorts.

Some of these commodity groupings do not appear to be very homogeneous. For example, the fruit and nut category includes apples and oranges, which differ greatly in production technologies. The cohort, however, is based on location as well as production specialty. A fruit cohort in the state of Florida will contain orange producers while the fruit cohort in the state of Washington will contain apple producers. Some studies suggest using farm size as a cohort parameter (Blank et al. 2004; Paul, Nehring, and Banker 2004). However, farm size does not remain constant over time (Hoppe and Korb 2005). Farm operations are growing or shrinking from year to year. This means that a cohort that uses farm size as a parameter may have many observations that would not remain in that cohort over time.

Table 1. Cohort Commodity Groupings

Group	Commodity
1	Barley, oats, wheat
2	Corn, soybeans, sorghum
3	Hay, miscellaneous, other crops
4	Fruits and nuts
5	Vegetables
6	Beef cattle
7	Sheep, hogs, other livestock
8	Poultry
9	Dairy

Note: A farm in which a given commodity accounts for at least 50% of the total value of production is defined as specializing in the production of that commodity.

Variables

Consumption is measured as total farm household expenditures in each year. Expenditures include food, housing, nonfarm transportation, medical, recreation, home improvements, and all other nonfarm consumption. The measure excludes expenditures on farm production inputs or farm investment. Total farm household net worth is used as a measure of wealth. It includes both farm and nonfarm assets less farm and nonfarm debts. Total off-farm income consists of both earned and unearned nonfarm income. Net farm income includes income from all farming activities minus the costs of those activities and excludes income from government sources. This measure is accrual based and includes both cash and noncash elements. Total government payments consist of decoupled payments, environmental payments, volatile government payments, or those payments that vary from year to year based on agricultural production outcomes and market conditions, and all other government payments to farm households.

Environmental subsidies combine CRP, WRP, and EQIP government payments. Decoupled subsidies are limited to production flexibility contract (PFC) payments for the years 1999, 2000, and 2001 (1996 FAIR Act) and direct payments for the years 2002, 2003, and 2004 (2002 FSRI Act).[6] Volatile subsidies consist of LDP and MLG. To provide more clear comparisons between decoupled and volatile subsidies, counter-cyclical payments are excluded from the decoupled category while disaster relief payments are excluded from the volatile category. While counter-cyclical payments are intended to be

[6] In 2002, the survey included both PFC and direct payments. These are added to get a total value of decoupled payments.

Table 2. Cohort Means of Relevant Variables for All Cross-Sections in 1990 Dollars

Variable	1999	2000	2001	2002	2003	2004
Consumption	14,866	15,760	15,927	16,906	20,286	19,846
	(305)	(401)	(372)	(426)	(457)	(339)
Total net worth	407,752	365,244	400,231	353,761	450,512	493,704
	(16,505)	(16,877)	(20,782)	(14,462)	(21,320)	(23,917)
Off-farm income	31,730	31,556	29,384	30,944	32,835	33,109
	(1,262)	(1,359)	(1,365)	(1,181)	(1,709)	(1,242)
Net farm income	8,309	5,211	11,627	7,884	21,134	19,850
	(2,458)	(1,722)	(4,267)	(1,691)	(8,532)	(3,605)
Decoupled payments	2,263	2,408	2,204	1,934	2,504	1,998
	(302)	(365)	(269)	(245)	(281)	(250)
Volatile payments	2,283	2,547	2,631	501	470	776
	(269)	(326)	(446)	(107)	(163)	(124)
Conservation payments	490	430	546	496	528	429
	(70)	(54)	(94)	(70)	(96)	(61)
Other govt. payments	1,834	2,265	2,130	1,777	2,261	1,324
	(186)	(248)	(237)	(243)	(312)	(192)

Note: Data are taken from the 1999–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. Off-farm income consists of both earned and unearned income. Standard deviations appear in parentheses.

decoupled from production decisions, they are paid out only when commodity prices fall below specified levels (Westcott 2005). Agricultural disaster relief payments are paid out to farms in regions where drought, flooding, or other natural disasters have significantly reduced agricultural output. All remaining government subsidies, including counter-cyclical payments and agricultural disaster relief payments, are combined into a single "other" category.

Table 2 shows the mean values of the relevant variables for all cohorts in each year. All values are farm household totals and are in real 1990 dollars.[7] Mean household consumption ranges from $14,866 in 1999 to $20,286 in 2003. Measures of farm household net worth range from $353,761 in 2002 to $493,704 in 2004. Mean values for off-farm income range from $29,384 in 2001 to $33,109 in 2004. Net farm income ranges from $5,211 in 2000 to $21,134 in 2003, displaying much more variability from year to year than off-farm income.

Decoupled payments are relatively stable, ranging from $1,934 in 2002 to $2,408 in 2003. More volatile government payments range in value from $470 in 2003 to $2,631 in 2001. Note that the more volatile government payments are lower in 2003 and 2004 when net farm income is at its highest and higher in 1999, 2000, and 2001 when net farm income is much lower. Government payments under environmental preservation programs range from $429 in 2004 to $546 in 2001. Other government payments, which include the counter-cyclical and disaster relief payments excluded from other categories, range from $1,324 in 2004 to $2,265 in 2000.

Results

The results are presented in three tables. Each table lists both OLS and IV parameter estimates. The results are generally similar for each of the econometric techniques used, implying little or no correlation between the independent variables and the error term. All specifications include a time period dummy variable (*YEAR*). Table 3 displays estimates for the marginal propensities to consume from three income sources: net farm income, off-farm income, and U.S. government subsidies. Table 4 displays estimates for more disaggregated income sources. Off-farm income is separated into earned and unearned income while government subsidies are separated into volatile, decoupled, conservation, and other payments. Because volatile payments are intended to smooth the incomes of farm households, volatile payments and net farm income are combined into one income source in table 5.

Table 3 shows that farm income is consumed at a marginal rate of 1% while off-farm income is consumed at a marginal rate of 10%. An *F*-test indicates that these two rates are

[7] Average consumption by year in nominal terms is $24,766; $27,139; $28,206; $30,412; $37,319; and $37,488 for the years 1999–2004, respectively.

Table 3. Marginal Propensity to Consume from Different Sources of Farm Household Income

	OLS		IV	
Variable	Estimate	Std. Error	Estimate	Std. Error
Intercept	7,154***	(644)	7,008***	(1,084)
Net farm income	0.01**	(0.003)	0.01*	(0.003)
Off-farm income	0.10***	(0.009)	0.10***	(0.010)
Subsidies	0.07***	(0.018)	0.07***	(0.021)
Net worth	0.004***	(0.001)	0.003***	(0.001)
Lagged consumption	0.15***	(0.027)	0.27***	(0.076)
Year is 2000	1,441***	(489)	–	
Year is 2001	1,523***	(486)	1.72	(510)
Year is 2002	2,677***	(486)	1,116**	(516)
Year is 2003	5,235***	(486)	3,619***	(527)
Year is 2004	4,194***	(493)	2,206***	(642)
R^2	0.348		0.317	

Note: Data are taken from the 1998–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. The dependent variable is farm household consumption. Parentheses indicate standard errors. Instrumental variable techniques employ as instruments twice-lagged consumption and lagged independent variables. Single asterisk (*), double asterisks (**), and triple asterisks (***) represent statistical significance at the 5%, 3%, and 1% levels, respectively.

Table 4. Marginal Propensity to Consume from Disaggregated Sources of Farm Household Income

	OLS		IV	
Variable	Estimate	Std. Error	Estimate	Std. Error
Intercept	7,226***	(650)	7,744***	(1,027)
Net farm income	0.01**	(0.003)	0.01**	(0.003)
Earned income	0.09***	(0.010)	0.10***	(0.012)
Unearned income	0.08***	(0.020)	0.07***	(0.021)
Volatile subsidies	0.02	(0.058)	0.02	(0.066)
Decoupled subsidies	0.22***	(0.058)	0.24***	(0.066)
Conserv. subsidies	−0.08	(0.153)	−0.05	(0.172)
Other subsidies	−0.14**	(0.064)	−0.16**	(0.069)
Net worth	0.004***	(0.001)	0.004***	(0.001)
Lagged consumption	0.15***	(0.027)	0.23***	(0.071)
Year is 2000	1,555***	(493)	–	
Year is 2001	1,541***	(486)	−81.00	(507)
Year is 2002	2,721***	(493)	1,072*	(526)
Year is 2003	5,203***	(497)	3,503***	(546)
Year is 2004	4,012***	(498)	2,078***	(639)
R^2	0.354		0.332	

Note: Data are taken from the 1998–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. The dependent variable is farm household consumption. Parentheses indicate standard errors. Instrumental variable techniques employ as instruments twice-lagged consumption and lagged independent variables. Single asterisk (*), double asterisks (**), and triple asterisks (***) represent statistical significance at the 5%, 3%, and 1% levels, respectively.

significantly different from one another. U.S. government subsidies are consumed at a marginal rate of 7%, not significantly different from the 10% rate estimated for off-farm income.[8] These results are consistent with those derived by Carriker et al. (1993), who estimate that off-farm income and government subsidies are consumed at statistically similar marginal rates of 5.2% and 4.8%, respectively. They estimate farm income to be consumed at the significantly lower marginal rate of 2.6%. In the analysis presented here, data are at the national level for the years 1998–2004 while Carriker et al. (1993) use data from the state

[8] Estimated marginal rates of consumption for off-farm income and government subsidies are not statistically different from each other at 1%, 3%, or 5% levels.

Table 5. Marginal Propensity to Consume from Combined Farm and Volatile Subsidy Sources of Income

	OLS		IV	
Variable	Estimate	Std. Error	Estimate	Std. Error
Intercept	7,145***	(641)	8,038***	(1,021)
Farm and volatile	0.01**	(0.003)	0.01**	(0.003)
Earned income	0.09***	(0.010)	0.10***	(0.012)
Unearned income	0.08***	(0.019)	0.07***	(0.021)
Decoupled subsidies	0.23***	(0.047)	0.25***	(0.053)
Conserv. subsidies	−0.07	(0.151)	−0.05	(0.169)
Other subsidies	−0.12*	(0.063)	−0.14*	(0.068)
Net worth	0.004***	(0.001)	0.004***	(0.001)
Lagged consumption	0.16***	(0.027)	0.20***	(0.070)
Year is 2000	1,559***	(489)	–	
Year is 2001	1,524***	(482)	−81.59	(502)
Year is 2002	2,695***	(482)	1,073**	(505)
Year is 2003	5,207***	(480)	3,545***	(516)
Year is 2004	3,890***	(489)	2,086***	(614)
R^2	0.362		0.345	

Note: Data are taken from the 1998–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. The dependent variable is farm household consumption. Parentheses indicate standard errors. Instrumental variable techniques employ as instruments twice-lagged consumption and lagged independent variables. Single asterisk (*), double asterisks (**), and triple asterisks (***) represent statistical significance at the 5%, 3%, and 1 % levels, respectively.

of Kansas for the years 1976–90, which may contribute to some of the differences in the magnitudes of the estimates.

Table 4 displays the results from disaggregating off-farm income and government payments. The marginal rate of consumption for farm income remains statistically significant and unchanged at 1%. Earned income is consumed at a marginal rate of 10% while unearned income is consumed at a marginal rate of 7%. Volatile government subsidies are consumed at a marginal rate that is not significantly different from zero. Decoupled payments, on the other hand, are consumed at the relatively high and statistically significant marginal rate of 24%. Conservation program payments have no significant effect on consumption while other government payments have a large negative correlation with consumption. Care should be taken in interpreting the impacts of "other" government payments on consumption. The category includes agricultural disaster payments, which may explain why they are negatively correlated with consumption. Years in which agricultural disaster payments are high are also years in which farm income, and therefore consumption, may be low. Further, the "other" category contains several government program payments enacted under the 2002 FSRI Act that were not present in the 1996 FAIR Act.

Because volatile payments are paid out when farm incomes tend to be lower, the two income sources combined may create a more stable source of income with a higher corresponding rate of marginal consumption. Net farm income is combined with more volatile government payments to create one income source. Table 5 shows that the estimated marginal rate of consumption for this combined income source is 1%, the same rate estimated for net farm income alone. Volatile government subsidies do not appear to contribute to consumption smoothing.

The results presented in tables 3 through 5 confirm the findings of Carriker et al. (1993), demonstrating that different types of farm household income lead to different consumption outcomes. This finding applies to disaggregated types of U.S. support to agriculture, implying that some domestic support programs are better suited than others in achieving policy objectives regarding farm household consumption. The results obtained here suggest that decoupled and volatile government payments are imperfect substitutes. Under the 2002 FSRI Act, a dollar of LDP does not contribute to marginal consumption while a dollar of direct payments increases marginal consumption by an estimated 25%. It appears that decoupled subsidies are better at contributing to marginal farm household

consumption than payments that vary according to market conditions.

While marginal rates of consumption estimated here and in other studies may seem low, it is important to note that they do not reflect the share of total income that goes to consumption, but rather, given an initial level of income and consumption, the share of each additional dollar that is consumed in the short run. The remaining additional dollar can also be saved, invested on the farm, or used to pay down debt. In the long run, consumption may adjust to higher levels of income. Further, Friedman (1957) hypothesizes that transitory income is fully saved, yielding a marginal rate of consumption equal to zero. Therefore, small changes in short-run marginal consumption in response to additional income are not surprising. However, if farm households are making savings and farm investment decisions in conjunction with farm household consumption decisions, a system of equations may be a more appropriate framework in which to model the consumption decision. This represents an area of potential research.

Correlated Independent Variables

This model utilizes independent variables that may be correlated with each other. For example, farm household net worth is likely to be higher for farm households with higher farm and nonfarm incomes. Decisions to work off farm may depend on the size of government payments received by the farm operation as well as income from farm production. It has also been proposed that decoupled payments may indirectly affect production decisions (Hennesy 1998; Young and Westscott 2000; Adams et al. 2001). Volatile government payments and conservation program payments are made when income from farm production is likely to be low.

To test the robustness of the results, consumption is regressed on each exogenous variable independently. Table 6 shows the results of these regressions, which indicate that the estimated parameters do not vary significantly when acting as the sole independent explanatory variable. In addition, variance inflation factors were also estimated. The largest was at 2.23 for decoupled payments. Variables are considered highly collinear when variance inflation factors are higher than four. Regardless, marginal rates of consumption for decoupled subsidies are positive and significant, while they are not significantly different from zero for more volatile government subsidies across the entire range of model specifications and econometric techniques used.

Table 6. Regressions with Only One Independent Variable

Variable	OLS
Net farm income	0.02***
	(0.003)
Earned income	0.09***
	(0.012)
Volatile subsidies	−0.01
	(0.050)
Decoupled subsidies	0.15***
	(0.048)

Note: Data are taken from the 1998–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. Dependent variable is farm household consumption. Parentheses indicate standard errors. Triple asterisks (***) represent statistical significance at the 1% level.

Alternative Cohort Specifications

It is possible that the results depend on the way in which the cohorts are constructed. To test the impact of cohort construction on the results, two alternative cohort constructions are used to estimate the impacts of disaggregated incomes on consumption. The first is determined by the state in which the farm operation is located and the age category of the farm operator. The second combines a production region variable with the actual age of the principal operator. In the second cohort construction, observations are classified such that the age group in a given state in a given

Table 7. Comparison of Marginal Propensity to Consume Under Alternative Cohort Specifications Using OLS

Variable	State and Production Specialty	State and Age Class	Region and Age
Net farm income	0.01**	0.03**	0.02
	(0.003)	(0.014)	(0.012)
Off-farm income	0.10***	0.13***	0.11***
	(0.009)	(0.008)	(0.007)
Subsidies	0.07***	0.10***	0.09***
	(0.018)	(0.037)	(0.035)

Note: Data are taken from the 1998–2004 Agricultural Resource Management Survey (ARMS) produced by the U.S. Department of Agriculture's National Agricultural Statistics Service. The dependent variable is farm household consumption. Independent variables not reported include lagged consumption, farm household net worth, and dummy variables for each year. Parentheses indicate standard errors. Single asterisk (*), double asterisks (**), and triple asterisks (***) represent statistical significance at the 5%, 3%, and 1% levels, respectively.

year is in the same cohort as the same age group in the same state in the following year, plus one year. For example, everyone who is fifty-nine in 1999 will be in the same cohort as everyone who is sixty in 2000, ensuring that if an observation is sampled in a later period, it will be in the same cohort. Table 7 shows that results are relatively robust across alternative cohort specifications.

Conclusion

This analysis presents estimates of marginal propensities to consume different sources of farm household income with particular emphasis given to various types of government agricultural subsidies. The theoretical model is taken from Carriker et al. (1993), while empirical considerations for estimations employing dynamic pseudo-panels are taken from McKenzie (2004). Using a pseudo-panel of data created from ARMS data sets for the years 1998–2004, it is shown that income from farm production is consumed at the margin at a rate nearly one-tenth that of off-farm income. It is also shown that the marginal propensity to consume decoupled government payments is positive and significant while the marginal propensity to consume more volatile government payments is not significantly different from zero. This suggests that a policy objective of smoothing farm household consumption might be better achieved with regular decoupled subsidies than with more variable types of support.

Traditional theories of consumption generally assume that income is fungible, or that income from one source is a perfect substitute for income from another source. However, some studies have found that marginal rates of consumption vary according to income source (Holbrook and Stafford 1971; Hsieh 2003; Baker, Nagel, and Wurgler 2006).[9] On what basis do households differentiate between sources of income? Friedman (1957) suggests that people with more volatile incomes will engage in consumption smoothing by saving more, yielding lower marginal rates of consumption. While Friedman (1957) refers to savings from total income, it may be that households differentiate between income sources based on their volatility, with volatile incomes leading to lower rates of marginal consumption. However, other theories of how households differentiate between income sources cannot be ruled out.

Thaler (1985) and Shefrin and Thaler (1988) suggest that economic agents categorize income into different "mental accounts" where the marginal propensity to consume income from each account may differ. These sorting rules may be based on income characteristics, such as size, or on more behavioral criteria such as the name of the payment (Thaler 1990, 1999). For example, Kooreman (2000) finds that the marginal propensity to consume children's clothing is higher for income derived from a government transfer payment labeled as a "child benefit" payment. The application of behavioral theories of consumption to agricultural policy is important if a stated policy objective may be better achieved by altering payment characteristics such as the size, frequency, term, or even name of the payment. Further research in agricultural policy should explore how farm household consumption responds to different income characteristics, such as payment size and frequency.

Additional research in this area should also consider the structure of the theoretical model presented here. Decisions to work off-farm may be made jointly with the decision to labor on the farm, both of which may depend on the amount of assistance received by the government (Ahearn, El-Osta, and Dewbre 2006). All of these decisions may be affected by both agricultural and nonagricultural levels of wealth. While the results generated in this article appear to be robust, a system in which these decisions are jointly determined may provide a more accurate picture of farm household consumption behavior.

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[9] For a more complete review of the literature and the various models traditionally used to explain the relationship between income and consumption, see Deaton (1992) and Browning and Crossley (2001).

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